TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	ATTORNEY'S DOCKET NUMBER 19391.0028 PCT
	U.S. APPLICATION NO. (If known, see 37 CFR 1.5) **09/914955**

INTERNATIONAL APPLICATION NO. PCT/SE00/00470	INTERNATIONAL FILING DATE 9 March 2000	PRIORITY DATE CLAIMED 12 March 1999

TITLE OF INVENTION
QUANTUM WELL BASED TWO-DIMENSIONAL DETECTOR FOR IR RADIATION AND CAMERA SYSTEM WITH SUCH A DETECTOR

APPLICANT(S) FOR DO/EO/US
Sten Lindau

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. § 371.
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [x] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. [x] A copy of the International Application as **published** (35 U.S.C. 371(c)(2))**WO 00/55922**
    a. [x] is transmitted herewith (required only if not transmitted by the International Bureau).
    b. ☐ has been transmitted by the International Bureau.
    c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
    a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
    b. ☐ have been transmitted by the International Bureau.
    c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
    d. ☐ have not been made and will not be made.

8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3).

9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. ☐ A translation of the Annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. Below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. [x] A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.

15. ☐ A change of power of attorney and/or address letter

16. [x] Other items or information:

    PCT/ISA/210
    PCT/ISA/220
    PCT/IB/308
    PCT/IPEA/409
    PCT/IPEA/416
    PCT/RO/101

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO. PCT/SE00/00470	ATTORNEY'S DOCKET NUMBER
09/914955	**518 Rec'd PCT/PTO 0 6 SEP 2001**	19391.0028

	CALCULATIONS	PTO USE ONLY

X The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)):

Search Report has been prepared by the EPO or JPO...$860.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) ....
....$690.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)).......................................$760.00

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO..$1,000.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)..$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =	**$1,000.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 [x] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 130.00	

Claims	Number Filed	Number Extra	Rate		
Total Claims	10 - 20 =	0	X $18.00	$	
Independent Claims	2 - 3 =	0	X $80.00	$	
Multiple dependent claim(s)(if applicable)			+ $270.00	$	

TOTAL OF ABOVE CALCULATIONS =	**$1,130.00**	
Reduction by 1/2 for filing by small entity, if applicable.	$	
SUBTOTAL =	**$1,130.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	
TOTAL NATIONAL FEE =	**$1,130.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	$	
TOTAL FEES ENCLOSED =	**$1,130.00**	

	Amount to be:	
	Refunded	$
	Charged	**$1,130.00**

a. ☐ A check in the amount of $___ to cover the above fees is enclosed.

b. [x] Please charge my Deposit Account No. **19-5127; 19391.0028** in the amount of **$1,130.00** to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [x] The Director is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **19-5127**. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

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NAME
37,134
REGISTRATION NUMBER

Atty Docket: 19391.0028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: :

Sten Lindau   :
                                         :
Application No.: U.S. National Phase   :   Examiner: --
              of PCT/SE00/00470   :
                                         :
Filed: September 6, 2001   :   Art Unit --

Title: QUANTUM WELL BASED TWO-DIMENSIONAL DETECTOR FOR IR RADIATION AND CAMERA SYSTEM WITH SUCH A DETECTOR

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

  Prior to examination, please amend the above-identification as follows:

In the Claims:

Please amend the claims as follows:

Clean Copy of Amended Claims

4. Detector according to claim 1, characterized in that elements 1f incorporated in the grating arrangement 9 in the horizontal section of the grating arrangement vary the configuration size

and/or shape and for example are square at the central part 1d of the detector surface and change to rectangular shapes as the grating arrangement 9 extends out towards the outer parts 1e or circumference of the detector surface.

5. Detector according to claim 1, characterized in that the interval 10, 11 of the grating arrangement is selected so that the detection or sensitivity of the detector is essentially the same over the whole surface 1a of the detector.

6. Detector according to claim 1, characterized in that the grating interval increases with the distance from the central parts of the detector out toward its outer parts or circumference 1e.

7. Detector according to claim 1, characterized in that the grating interval varies according to

$$d(x) = \frac{\lambda}{n - \sin \alpha_{0\,max}(x)}$$

where λ is the wavelength, n is the diffraction index of the grating substrate and $\alpha_{0max}(x)$ is the maximum angle of incidence and is given by the formula

$$\tan \alpha_{0\,max}(x) = \frac{x + D/2}{S}$$

9. Detector according to claim 1, characterized in that the grating interval has values of approximately 2.5-3.0 micrometres at the centre of the detector and approximately 3.0-3.5

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micrometres at the outer parts of the detector, where the higher values within both areas are related to each other and the lower values within both areas are related to each other.

Amended Claims

4. (Amended) Detector according to claim 1, [2 or 3,] characterized in that elements 1f incorporated in the grating arrangement 9 in the horizontal section of the grating arrangement vary the configuration size and/or shape and for example are square at the central part 1d of the detector surface and change to rectangular shapes as the grating arrangement 9 extends out towards the outer parts 1e or circumference of the detector surface.

5. (Amended) Detector according to [any of the preceding claims] claim 1, characterized in that the interval 10, 11 of the grating arrangement is selected so that the detection or sensitivity of the detector is essentially the same over the whole surface 1a of the detector.

6. (Amended) Detector according to [any of the preceding claims] claim 1, characterized in that the grating interval increases with the distance from the central parts of the detector out toward its outer parts or circumference 1e.

7. (Amended) Detector according to claim 1[or any of claims 2-6], characterized in that the grating interval varies according to

$$d(x) = \frac{\lambda}{n - \sin \alpha_{0\,max}(x)}$$

3

where λ is the wavelength, n is the diffraction index of the grating substrate and $\alpha_{0max}(x)$ is the maximum angle of incidence and is given by the formula

$$\tan a_{0\,max}(x) = \frac{x + D/2}{S}$$

9. (Amended) Detector according to claim 1[or any of claims 2-7], characterized in that the grating interval has values of approximately 2.5-3.0 micrometres at the centre of the detector and approximately 3.0-3.5 micrometres at the outer parts of the detector, where the higher values within both areas are related to each other and the lower values within both areas are related to each other.

Remarks

Applicants have amended the claims to eliminate multiple dependencies to reduce the filing fee.

Respectfully submitted,

Date: September 6 , 2001

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Quantum well based two-dimensional detector for IR radiation and camera system with such a detector

This invention concerns a quantum well based two-dimensional detector for detecting infrared radiation which receives infrared radiation falling upon its detector surface at various angles of incidence within a range of 0-30° in relation to the normal to the surface. The detector comprises a grating arrangement for diffraction of the incident radiation. The invention also concerns a camera system for infrared radiation and comprising optics with an aperture and cooling unit and a quantum well based two-dimensional detector which receives via the aperture infrared radiation falling at various angles of incidence within a range of 0-30° in relation to the normal to the detector surface. The detector comprises in addition a grating arrangement for diffraction of the incident radiation.

The use of diffraction gratings of various kinds is already known for the purpose of increasing the sensitivity of a quantum well based detector for detecting infrared radiation, a so-called QWIP detector (Quantum Well Infrared Photodetector). Reference can be made to the Swedish patent 9101034 and the American patents 5 075 749 and 5 506 419. QWIP detectors are completely insensitive to radiation which falls perpendicular to the surface, but by the introduction of a grating the direction of the incident radiation can be changed so that this can be absorbed by the detector structure. The grating is normally arranged so that the detector is most sensitive to radiation falling perpendicular to the detector surface.

The use of such detectors in IR camera systems is already known, where the detectors are combined with optics and cooling devices. An important component in

this respect is the so-called cold aperture which is usually integrated with the detector in a vacuum flask (Dewar vessel). The cold aperture limits the angles of incidence of the radiation which falls on the detector.

5   A QWIP detector which is equipped with a through-put grating as above is usually sensitive within a relatively narrow range of angles. In particular this applies when a grating arrangement is used in accordance with the abovementioned Swedish patent,

10   where the grating constant or grating interval is selected so that the angles of diffraction are almost 90°. It only requires a very small change in the angle of incidence for the angle of diffraction to exceed 90° in relation to the normal to the detector surface

15   whereupon the diffracted ray in question is lost as an active component in the detection, which results in a sudden reduction in the through-put efficiency.

In order for radiation to be detected by the detector it is necessary for the angles of incidence to

20   lie within a range of angles where the detector is sensitive. For points which lie straight in front of the detector, that is straight in front of the cold aperture, all these rays will lie within a range of angles around 0°, which means that most of the radiation

25   can be detected. On the other hand for points at the edge of the detector surface the rays fall principally at oblique angles, where previously known detectors have poor sensitivity. This is shown in figures 1 and 2 where A shows the radiation falling on the centre of

30   the detector surface via the cold aperture and B shows the radiation falling on the outer edges of the detector surface via the cold aperture. There is a need to be able to obtain even sensitivity over the whole detector surface in order to be able to achieve a

35   better picture quality. This invention aims to solve this problem, among others.

In connection with the camera system there is also the requirement to be able to make the optics smaller

and reduce the cooling requirement in the system. The
invention also intends to solve this problem.

A detector according to the invention can
principally be characterized in that the grating
5   arrangement is selected with a grating interval which
varies or changes from the central part of the detector
or the detector surface out towards the outer parts or
circumference of the detector or detector surface. It
is further characterized in that the variation or
10   change in the grating interval is arranged to retain or
contribute towards retaining in the detection
diffracted rays of the orders of 1 and -1 as active
components over the whole detector surface by changing
the angle value of the diffracted rays depending upon
15   the angles of incidence of the radiation falling upon
the various parts of the detector surface.

In the embodiments of the invention concept it is
proposed that the grating interval varies linearly or
in steps. Elements included in the grating arrangement
20   vary in the horizontal cross-section of the grating
arrangement in configuration size and/or shape and are,
for example, square in the central part of the detector
surface and change to a rectangular form in the part of
the grating arrangement towards the outer parts or
25   around the circumference of the detector surface.
Further embodiments of the invention concept are
described in the following patent claims regarding the
construction of the detector.

A camera system according to the invention can
30   principally be characterized in that, as described
above, the grating arrangement is selected with a
grating interval which varies or changes from the
central part of the detector out towards the outer
parts of the detector and that the grating interval or
35   the change is selected to diffract rays which pass
through the edge of the aperture, that is rays with the
largest angle of incidence, by a value up to or exactly
equal to 90° in relation to the normal to the detector
surface. Other rays which pass through the aperture are

diffracted by smaller angles than the abovementioned value, but are still close to 90°. The abovementioned values are selected preferably within the range approximately 85° - 90°.

5   By means of the invention described above a more even and more stable sensitivity is obtained over the whole detector surface which, as described above, gives a better picture quality. In connection with the new camera system this can be further refined in relation

10   to the current technology.

DESCRIPTION OF THE FIGURES:

In the following a currently proposed embodiment of a detector and a camera system according to the

15   invention will be described with reference to the attached figures, where

figure 1   shows in principal diagram form and from the side IR radiation falling through an

20   aperture onto the centre of the detector surface in accordance with already known technology,

figure 2   shows in principal diagram form and from the side radiation falling through an aperture

25   onto the outer edge of the detector related to the sensitivity area of the detector, where the figure shows the case for known technology,

figure 3   shows in horizontal view from underneath and

30   in principle a first embodiment of a detector with the new grating arrangement, not to scale,

figure 4   shows in horizontal view from underneath and in principle a second embodiment of the

35   detector's grating arrangement, not to scale,

figure 5   shows in diagrammatic form the linearly increasing grating interval from the centre of the detector surface out towards one outer edge of the detector surface,

figure 6   shows   in   diagrammatic   form   the   grating
interval increasing or changing in steps from
the centre of the detector surface out
towards one outer edge of the detector,

5   figure 7   shows in principal diagram form the case when
diffracted rays are lost as active components
in reproduction in detectors of known types,
and

figure 8   shows   in   principal   diagram   form   the

10   diffraction of the infrared radiation falling
on the detector surface at an angle via the
aperture in accordance with the invention
where the rays falling on the first edge of
the detector surface are reproduced.

15   Figures 1 and 2 refer principally to the problems
which are associated with already known detectors and
camera systems. Figure 1 shows a radiation area A for
the incident infrared radiation which falls on the
detector 1 at the central parts 1b of its detector

20   surface 1a. Detector 1 can be of a known type and in
this connection reference is made to the Swedish and
American patents mentioned in the introduction which
concern the construction of a so-called QWIP detector.
A so-called cold aperture is indicated by 2. The

25   centrally incident radiation is shown by arrows and
lines 3 and 4. The detector is principally sensitive
within an area which is represented by the angle α.
From the figure it can be seen that the area of
sensitivity (the cone) covers the whole of the opening

30   of the aperture 2a. The incident radiation 3, 4 falls
within the area of sensitivity 5, 6 of the detector
over all its extent, which indicates that the detector
has a high degree of sensitivity for the incident
radiation.

35   Figure 2 shows that the area of sensitivity of the
detector 1' at the outer edge 1c of the detector
surface 1a' is only partially accessible to infrared
radiation falling at oblique angles, which area is
indicated by ß. Only a small part can therefore be

detected by the detector, which gives a lower degree of
sensitivity for the reception by the detector of the
incident oblique radiation. The area of sensitivity of
the detector only covers a part of the incident

5   radiation 3', 4'. See also the broken lines 5', 6' in
figure 2 which show that the area of sensitivity only
partially covers the opening 2a' in the aperture.
Figure 2 also shows the construction of an IR camera K
based on the QWIP detector 1'. The camera comprises an

10   optics part O and a cooling unit KE. The abovementioned
components are already known and are incorporated in
the camera body KS in a known way. In figure 2 the
diameter of the aperture is indicated by D and the
distance between the aperture and the upper surface 1a'

15   of the detector is indicated by S.

In accordance with the invention the grating
structure is to be changed according to the angle of
incidence of the incident radiation. This means
preferably that the grating interval is longer at the

20   edge of the detector than in the centre. The grating is
preferably two-dimensional in order to be insensitive
to polarization of the radiation. Figure 3 shows a
grating arrangement viewed from the underside of the
detector in question. The detector is indicated in the

25   diagram by 1". The grating element in the embodiment is
constructed with quadrilateral configurations. At the
central parts 1d of the grating arrangement or of the
detector the grating elements are essentially square
while at the outer edge 1e of the detector they are

30   essentially rectangular. A grating element is indicated
by 1f in figure 3. The figure is not drawn to scale,
but is only an outline diagram.

In accordance with a first embodiment of the
invention concept the grating interval varies linearly

35   from the centre 1d of the detector out towards the
outer edge 1e of the detector.

The abovementioned variation or change in the
grating interval can according to figure 4 be arranged
in steps increasing out from the central part 1d' of

the detector to the outer edge 1e' of the detector. In
the embodiment according to figure 4 the increase in
steps in the grating arrangement is arranged using
strip-shaped formations 1g and 1h which in principle

5   cross each other at the central part 1d' of the
detector. In this way a first density in the grating
arrangement is obtained in the area which is covered by
both strips 1g and 1h. In parts which are individually
covered by the strip-shaped arrangements 1g and 1h a

10 second density is obtained in the grating arrangement.
In the corners of the grating arrangement which are
symbolized by 1i a third density is obtained for the
grating arrangement. The corners 1i are not crossed by
the strip-shaped structures 1g and 1h. The grating

15 interval is smaller at the central parts and increases
out towards the outer parts.

The grating arrangement can extend from the
central parts of the detector surface out towards the
outer edges of the detector surface with grating

20 intervals or steps increasing in principle in all
directions which are indicated by 1k, 1l, 1m and 1k',
1l', 1m' respectively in figure 1.

Figure 5 is intended to show the linearly
increasing grating interval in the grating arrangement

25 from the central part 1d of the detector 1" out towards
its straight outer edge 1e. In a corresponding way
figure 6 is intended to show the grating interval
increasing in steps from the centre 1d' of the detector
1"' out towards the outer edge 1e' in figure 4.

30 Figure 7 is intended to show the situation with
already known technology. In this case the aperture is
indicated by 2a" and the incident ray with the largest
angle to the upper surface 1a" of the detector is
indicated by 7. Figure 7 is intended to show that

35 diffracted rays of the order 1 have been given an angle
ß in relation to the normal 8 to the surface, which
angle is greater than 90°. This means that the rays in
question are lost as active components in the detection
or recording. In figure 7 an angle (gamma) is indicated

between the incident radiation and the normal 8 to the
surface. This maximum angle is preferably selected
within the range 0-45°.

Figure 8 shows the improvement according to the
5   invention. The incident radiation 7' which corresponds
to the incident radiation 7 in figure 7 is diffracted
with diffraction rays of the orders 1 and -1 according
to the figure. By the suitable selection of the grating
interval the diffraction rays of the order 1 assume a
10   value ß' which is 90° or very near 90°, which means that
the rays in question can be retained as active
components, which means that the sensitivity of the
detector is increased.

In a preferred embodiment the variation of the
15   grating interval is selected over the detector surface
in accordance with the following. The starting point is
a given aperture diameter D (see figure 2) at the
distance S (see figure 2) from the surface 1a' of the
detector. A grating interval d(x) for a point at the
20   distance x (see figure 2) from the centre 1d of the
detector (see figure 3) is selected in such a way that
the ray which has the largest angle of incidence is
diffracted by precisely 90° in relation to the normal.
This ray passes precisely at the edge of the aperture.
25   All other rays which pass through have a smaller angle
of incidence and are therefore diffracted by angles
less than but close to 90° (see above). Expressed
mathematically the grating interval is:

$$d(x) = \frac{\lambda}{n - \sin\alpha_{0max}(x)}$$

30

where λ is the wavelength, n is the diffraction index
of the grating substrate and $\alpha_{0max}(x)$ is the maximum
angle of incidence and is given by the formula:

35

$$\tan\alpha_{0max}(x) = \frac{x + D/2}{s}$$

In a second preferred embodiment the grating interval is selected according to a simplified method derived from the method above, by approximation of $\sin\alpha_{0max}$ and $\tan\alpha_{0max}$ by α_{0max}. The grating interval is
5 then given by

$$d(x) = \frac{\lambda}{n}\left(1 + \frac{D}{2nS} + \frac{x}{nS}\right)$$

that is the grating interval varies linearly from the
10 centre out towards the edges.

In an embodiment the following values are selected: λ = 9 μm, D = 7 mm and S = 14 mm. For the substrate or the material GaAs n = 3.28. At the centre of the detector d = 2.95. At the edge, for example 8 mm
15 from the centre, d = 3.43 μm. In an embodiment d is selected at the centre of the detector within a range 2.5 - 3.0 μm and at the outer edge of the detector within a range 3.0 - 3.5 μm, where the higher values are related to each other within both areas, as are the
20 lower values.

Selection of the grating interval d for the value of ß' equal to or close to 90° is obtained by means of

$$\frac{\sin\alpha_0}{n} + \sin\beta_m = \frac{m\lambda}{nd}$$

25

The abovementioned grating arrangement has been given the designation 9 in figure 3 and a graph for the periodicity according to figure 3 has been given the designation 10 in figure 5, while the graph for the
30 periodicity according to figure 4 has been given the designation 11 in figure 6.

This invention is not restricted to the embodiments described above, but can be modified within the framework of the following patent claims and
35 invention concept.

PATENT CLAIMS:

1.   Quantum well based two-dimensional detector 1 for detecting infrared radiation 3, 4 which receives infrared radiation falling upon its detector surface 1a at various angles of incidence preferably within a range of 0-45° in relation to the normal 8 to the surface and comprising a grating arrangement 1f for diffraction of the incident radiation, characterized in that the grating arrangement is selected with a grating interval which varies or changes from the central part 1d of the detector out towards the outer parts 1e or circumference of the detector, and that the variation or change in the grating interval is arranged to retain or contribute towards retaining in the detection diffracted rays of the orders 1 and -1 as active components across the whole detector surface by changing the angle values of the diffracted rays depending upon the angles of incidence α of the radiation falling on the various parts of the detector surface.

2.   Detector according to claim 1, characterized in that the grating interval varies linearly.

3.   Detector according to claim 1, characterized in that the grating interval varies in steps.

4.   Detector according to claim 1, 2 or 3, characterized in that elements 1f incorporated in the grating arrangement 9 in the horizontal section of the grating arrangement vary the configuration size and/or shape and for example are square at the central part 1d of the detector surface and change to rectangular shapes as the grating arrangement 9 extends out towards the outer parts 1e or circumference of the detector surface.

5.   Detector according to any of the preceding claims, characterized in that the interval 10, 11 of the grating arrangement is selected so that the detection or sensitivity of the detector is essentially the same over the whole surface 1a of the detector.

6.   Detector according to any of the preceding claims, characterized in that the grating interval increases with the distance from the central parts of the detector out towards its outer parts or circumference

5   le.

7.   Detector according to claim 1 or any of claims 2-6, characterized in that the grating interval varies according to

$$d(x) = \frac{\lambda}{n - \sin\alpha_{0max}(x)}$$

10

where λ is the wavelength, n is the diffraction index of the grating substrate and $\alpha_{0max}(x)$ is the maximum angle of incidence and is given by the formula

15

$$\tan\alpha_{0max}(x) = \frac{x + D/2}{S}$$

8.   Detector according to claim 7, characterized in that the grating interval is selected by approximation of $\sin\alpha_{0max}$ and $\tan\alpha_{0max}$ by α_{0max}, where the grating

20   interval is given by

$$d(x) = \frac{\lambda}{n}\left(1 + \frac{D}{2nS} + \frac{x}{nS}\right),$$

that is the grating interval varies linearly from the

25   centre out towards the edges.

9.   Detector according to claim 1 or any of claims 2-7, characterized in that the grating interval has values of approximately 2.5-3.0 micrometres at the centre of the detector and approximately 3.0-3.5

30   micrometres at the outer parts of the detector, where the higher values within both areas are related to each other and the lower values within both areas are related to each other.

10. Camera system for infrared radiation and

35   comprising optics O with aperture 2 and cooling unit KE and a quantum well based two-dimensional detector 1

which receives via the aperture infrared radiation 3, 4 falling at various angles of incidence α preferably within a range of 0-45° in relation to the normal 8 to the detector surface, where the detector comprises a

5   grating arrangement for diffraction of the incident radiation characterized in that the grating arrangement is selected with a grating interval which varies or changes from the centre of the detector out towards the outer parts of the detector and in that the grating

10   interval or the change is selected to diffract the rays 7′ which pass through the edge of the aperture 2a″, that is the rays with the largest angle of incidence, by a value up to or exactly equal to 90° and to diffract rays with smaller angles of incidence by values which

15   are less than the abovementioned value but are still close to 90°, which values are preferably selected within the range 85° - 90°.

Fig.1

Fig.2

Fig. 4

Fig. 6

Fig. 3

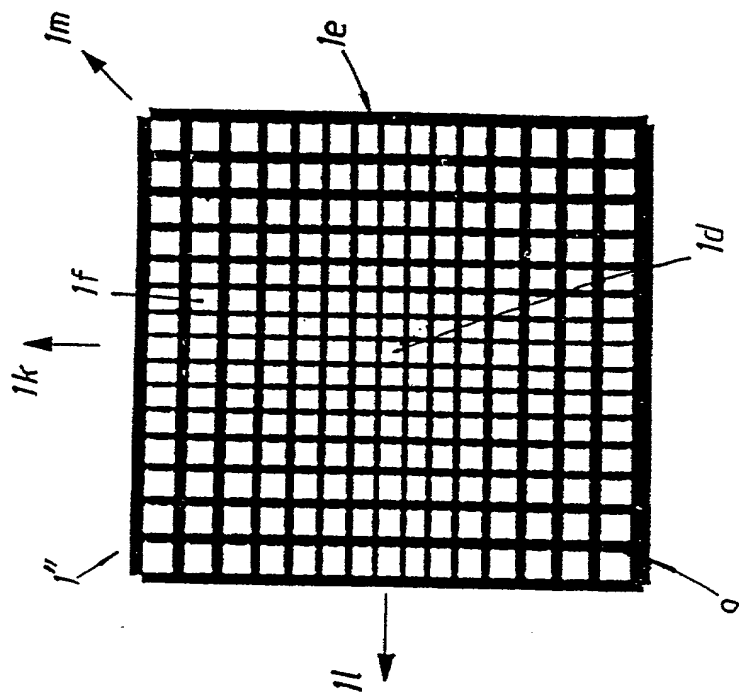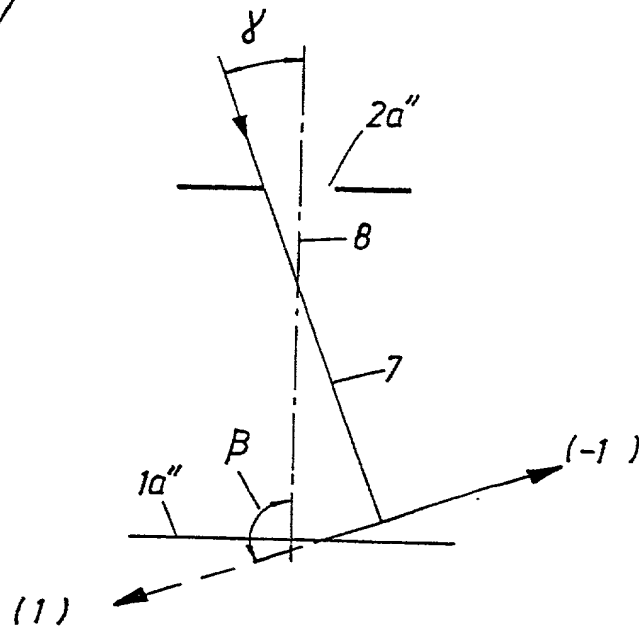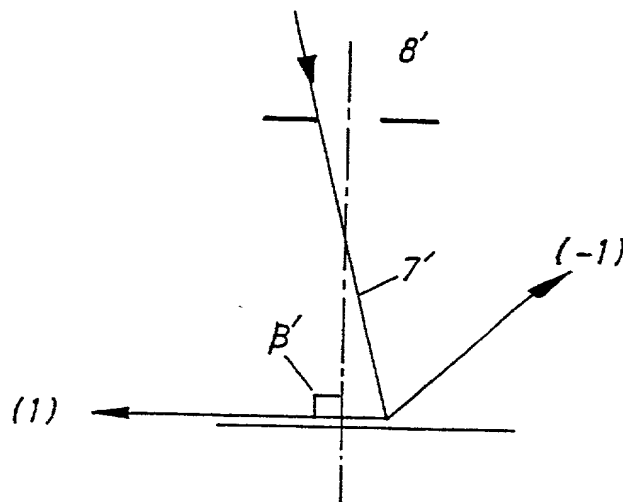Fig. 5

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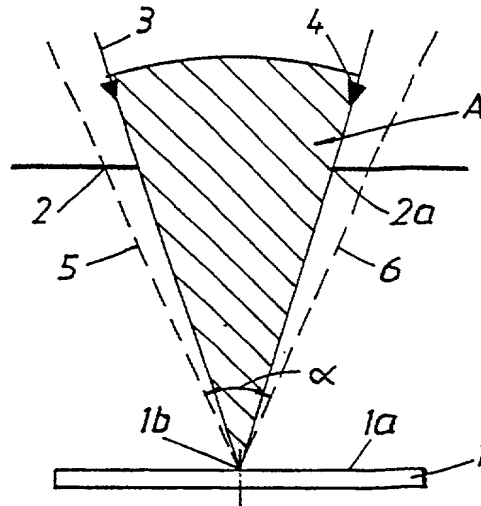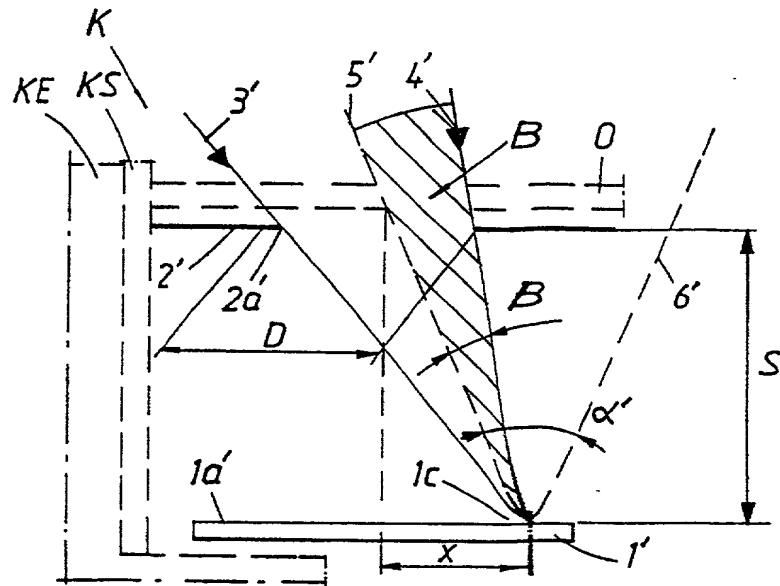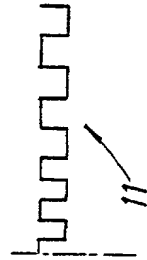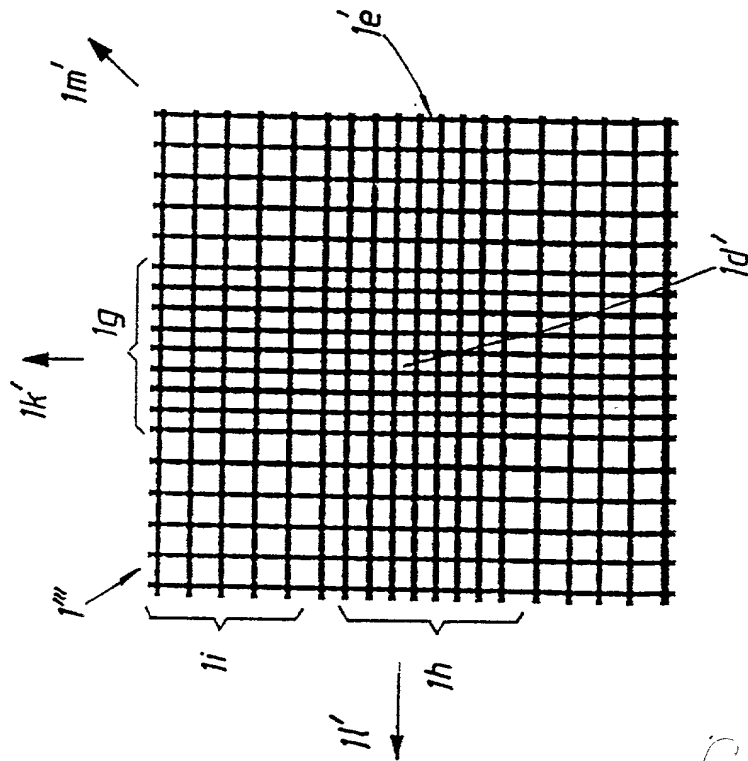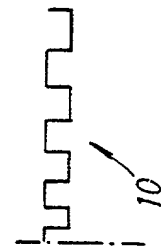
Fig. 7

Fig. 8

COMBINED DECLARATION AND POWER OF ATTORNEY FOR
ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL,
DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

QUANTUM WELL BASED TWO-DIMENSIONAL DETECTOR FOR IR RADIATION AND CAMERA SYSTEM WITH SUCH A DETECTOR

the specification of which

a. ☐ is attached hereto

b. ☐ was filed on _____ as application Serial No. _____ and was amended on _____. (if applicable).

PCT FILED APPLICATION ENTERING NATIONAL STAGE

c. ☒ was described and claimed in International Application No. PCT/SE00/00470 filed on 9 March 2000 and as amended on _____. (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56.

I hereby specify the following as the correspondence address to which all communications about this application are to be directed:

SEND CORRESPONDENCE TO: Edward A. Pennington
                            SWIDLER BERLIN SHEREFF FRIEDMAN, LLP
                            3000 K Street, N.W., Suite 300
                            Washington, D.C. 20007-5166

DIRECT TELEPHONE CALLS TO: Eric J. Franklin, 202-424-7500

☒   I hereby claim foreign priority benefits under Title 35, United States Code § 119 (a)-(d) or under § 365(b) of any foreign application(s) for patent or inventor's certificate or under § 365(a) of any PCT international application(s) designating at least one country other than the U.S. listed below and also have identified below such foreign application(s) for patent or inventor's certificate or such PCT international application(s) filed by me on the same subject matter having a filing date within twelve (12) months before that of the application on which priority is claimed:

1

☒ The attached 35 U.S.C. § 119 claim for priority for the application(s) listed below forms a part of this declaration.

Country/PCT	Application Number	Date of filing (day, month, yr)	Date of issue (day, month, yr)	Priority Claimed
Sweden	9900885-6	12 March 1999		☒ Y ☐ N
				☐ Y ☐ N
				☐ Y ☐ N

☐ I hereby claim the benefit under 35 U.S.C. § 119(e) of any U.S. provisional application(s) listed below.

Provisional Application No.   Date of filing (day, month, yr)

———

ADDITIONAL STATEMENTS FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART OR PCT INTERNATIONAL APPLICATION(S DESIGNATING THE U.S.)

I hereby claim the benefit under Title 35, United States Code § 120 of any United States application(s) or under § 365(c) of any PCT international application(s) designating the U.S. listed below.

US/PCT Application Serial No.   Filing Date,   Status (patented, pending, abandoned)/ U.S. application no. assigned (For PCT)

US/PCT Application Serial No.   Filing Date,   Status (patented, pending, abandoned)/ U.S. application no. assigned (For PCT)

☐ In this continuation-in-part application, insofar as the subject matter of any of the claims of this application is not disclosed in the above listed prior United States or PCT international application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or Imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorneys and/or agents with full power of substitution and revocation, to prosecute this application, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith: Edward A. Pennington (Reg. No. 32,588), John P. Moran (Reg. No. 30,906), Eric J. Franklin (Reg. No. 37,134), Michael A. Schwartz (Reg. No. 40,161), Robert C. Bertin (Reg. No. 41,488), Alicia A. Meros (Reg. No. 44,937), Chadwick A. Jackson (Reg. No. 46,495), Edward J. Naidich (Reg. No. 43,826), and Sean O'Hanlon (Reg. No. 47,252) of Swidler Berlin Shereff Friedman having an address of 3000 K Street, N.W., Suite 300, Washington, D.C. 20007-5116.

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Full name of second inventor

Inventor's signature

Date:

Residence:

Citizenship:

Post Office Address:

☐   ATTACHED IS ADDED PAGE TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR SIGNATURE BY THIRD AND SUBSEQUENT INVENTORS FORM.

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